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Flow control means

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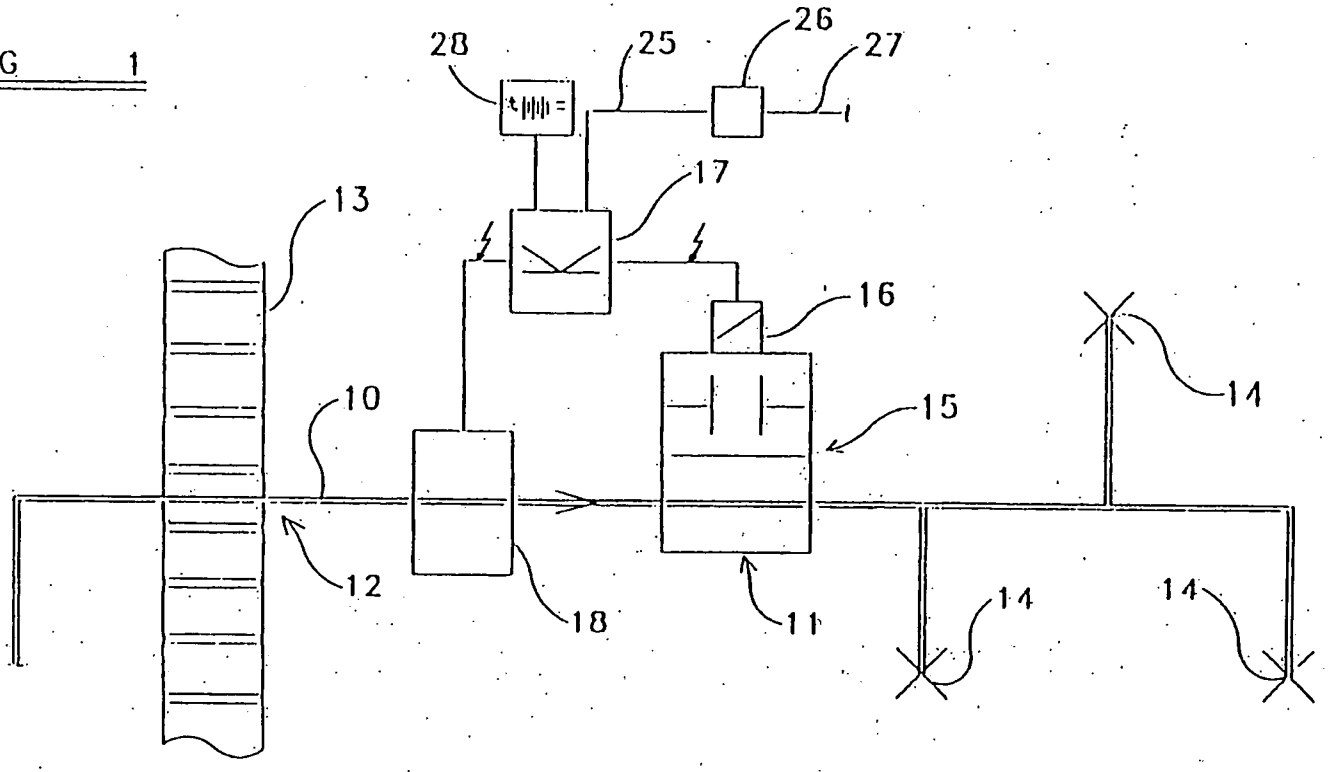
FIG 1



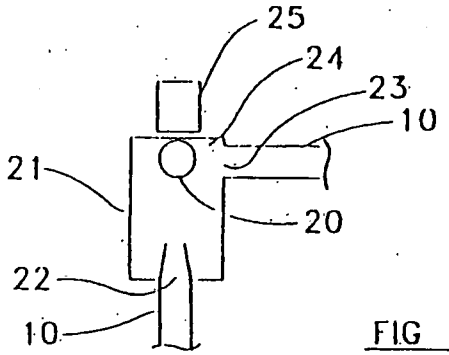


FIG 2

2 320 351

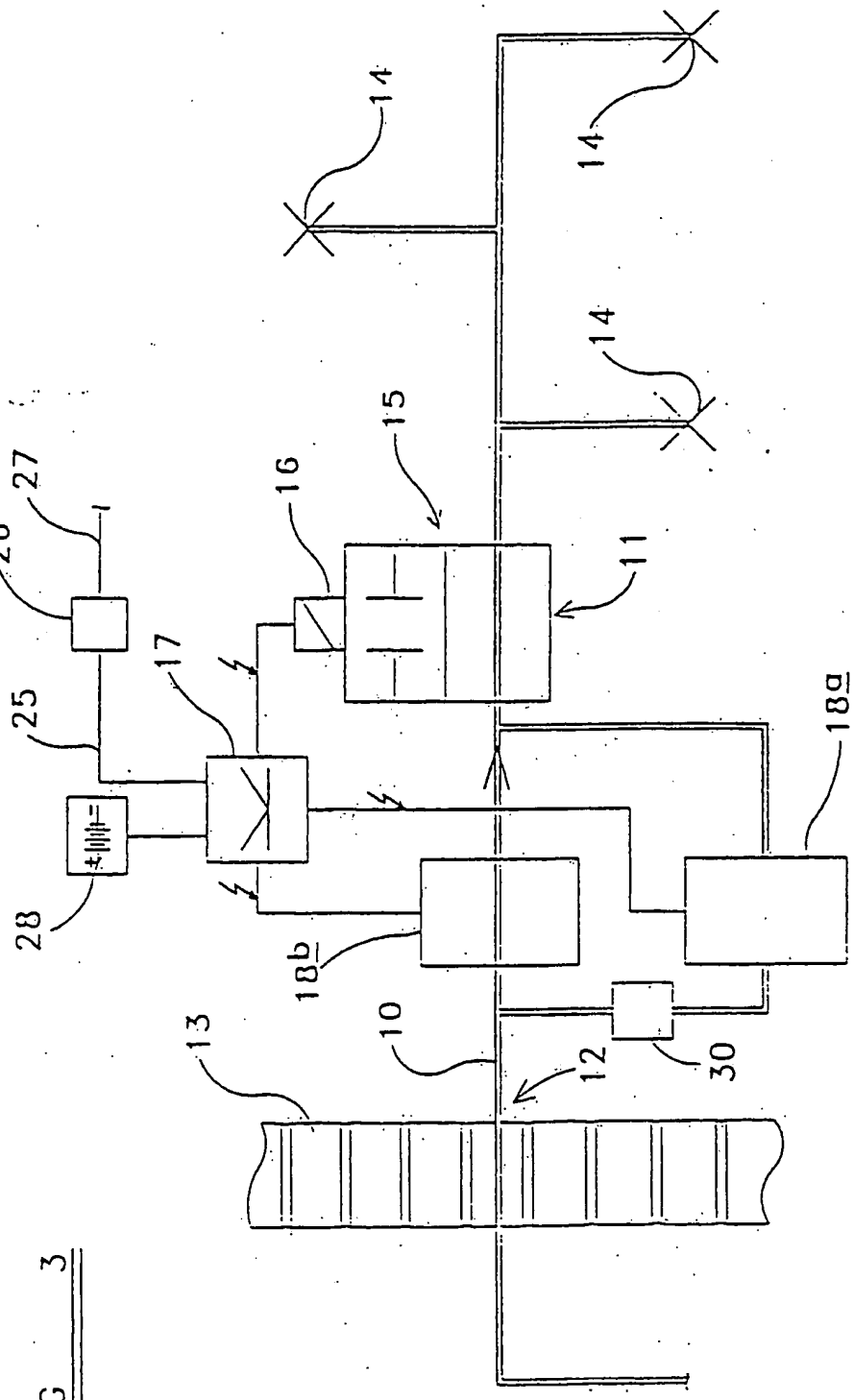


FIG 3

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PATENTS ACT 1977
JNL/H8565WO/8B

Title: "Flow Control Means"

This invention relates to a flow control means.

An object of the invention is to provide a new and improved flow control means.

According to one aspect of the present invention we provide a flow control means comprising a flow sensing means, a valve means, actuating means to move said valve means between an open and a closed condition, and a control means to cause said actuating means to move said valve means between said open and closed conditions, in accordance with a predetermined flow of said fluid, wherein the control means comprises means to move said valve means to said closed condition to interrupt flow of fluid therethrough upon intermittent flow of fluid past said sensing means.

The flow control means may further comprise means to move said valve means to said closed condition to interrupt the flow of fluid therethrough after uninterrupted flow of fluid past said flow sensing means for a predetermined period.

The flow sensing means may comprise at least one of:

a) a first flow sensing means adapted to sense a relatively high flow rate and wherein said control means causes said acdtuating means to move said valve means to said closed condition to interrupt said flow of fluid therethrough after said uninterrupted flow of fluid past said first flow sensing means for said predetermined time period, and/or upon said intermittent flow of fluid past said first flow sensing means,

b) a second flow sensing means adapted to sense a relatively low flow rate and wherein said control means is adapted to cause said actuating means to move said valve means to said closed condition to interrupt flow of fluid therethrough upon said intermittent flow of fluid past said

second flow sensing means and/or after uninterrupted flow of fluid past said second flow sensing means for a predetermined time period.

When both a first flow sensing means and a second flow sensing means is provided the valve means, actuating means, and control means may comprise a common component associated with the two flow sensing means or alternatively, the first flow sensing means may be associated with a first valve means and/or a first actuating means and/or a first control means whilst the second flow sensing means is associated with a second valve means and/or a second actuating means and/or a second control means.

The valve means may be provided in. for example, a water supply to a domestic, commercial or industrial, or other premises.

In the event of a leak occurring, the leak may be relatively major. This may be due to the system having either no storage tank or a large leak upstream of a storage tank leading to the water flow being at a relatively high flow rate and continuous for a longer period of time than a predetermined time period and so the first flow sensing means will cause the valve means to move to its closed condition to stop the flow. Alternatively, the major leak may be due to rapid repeated filling up of a storage tank due to a large leak downstream of the tank leading to intermittent flow at a relatively high flow rate. However, if there is no such leak there will either be no high flow rate or the high flow rate will be interrupted by the users before the expiration of the time period so that the first valve would not be moved to its closed position.

Alternatively, when a leak occurs the leak may be a relatively minor leak. This may be due to a small leak downstream of a storage tank leading to topping up of the storage tank. This may, for example, be due to repeated opening of an inlet valve, such as a ball cock, of the tank. This leads to the water flow being at a relatively low flow rate but being intermittent. In this case such intermittent low flow rate is sensed by the second flow sensing means and so the valve means will be caused to move to its closed condition to stop the flow. However, if there is no such leak there will be no low intermittent flow rate,

either because there is no leak or because such low intermittent flow rate will be prevented by virtue of intervention by the users so that the flow is not stopped.

Alternatively, topping up of a storage tank may be by virtue of a relatively low continuous flow, for example, where the inlet valve to the storage tank opens a small amount which matches or substantially matches the rate of leakage from the tank or where there is a low continuous flow due to a small leak upstream of the storage tank or where no storage tank is provided.

Usually, different flow sensing means are needed for sensing the relatively major and the relatively minor leaks. However, if desired the same device may be utilised to provide said first and/or said second flow sensing means.

The or each flow sensing means may comprise a rotary impeller caused to rotate by flow of said fluid or a sensing element moved by flow of said element towards a sensing position whereat presence of the sensing element is determined by a proximity sensor such as a magnetic proximity sensor.

The or each actuating means may comprise a solenoid.

The or each valve means may comprise a gate valve, the gate being moveable between said open and closed positions by said solenoid.

Alternatively, the or each valve means may comprise a butterfly type valve, the butterfly being rotated by said solenoid between said open and closed positions.

Alternatively, the or each valve means may comprise a valve member moveable into and out of sealing engagement with a valve seat in the direction of flow of fluid past the seat by said solenoid.

The solenoid may move the valve means between both conditions in either direction or may move the valve means in one direction and resilient biasing means being provided for return movement.

The or one of the control means may comprise a timing device and logic means to determine whether or not flow has stopped before the timing device has measured said predetermined time period.

If high flow rate has stopped before the predetermined time period has elapsed, the control means is reset to restart measuring the time period.

Alternatively, if the flow continues after the predetermined time period has elapsed the actuating means is caused to move the valve means to the closed condition.

The or one of the control means may comprise a timing device and logic means to determine whether or not flow is intermittent.

Means may be provided to prevent the valve means being opened until the control means has been manually reset after movement of the valve means to the closed condition.

The predetermined time period may be adjustable.

The flow control means may be provided with a primary power supply such as a low voltage supply transformed from a mains supply.

The flow control means may be provided with a secondary power supply such as a battery.

A manual override may be provided to enable the or each valve to be manually moved to its open or its closed condition.

The control means may be arranged to cycle the or each valve between said open and closed conditions, for example, at predetermined time intervals, to ensure that the valve operation does not become obstructed, such as by the formation of scale.

According to a second aspect of the present invention we provide a method of flow control comprising means to interrupt said flow in accordance with a predetermined flow of said fluid, comprising the step of interrupting flow of fluid upon intermittent flow of fluid.

The method may further comprise the step of interrupting flow of fluid after uninterrupted flow of fluid for a predetermined time period.

The method may comprise at least one of the following steps:

a) sensing a first relatively high flow rate and interrupting flow of fluid after said uninterrupted fluid for a first predetermined time period and/or upon said intermittent flow of fluid,

b) sensing a second relatively low flow rate and interrupting flow of fluid upon said intermittent flow of fluid and/or after said uninterrupted flow of fluid for said predetermined time period.

In this specification, by "intermittent flow" we mean intermittent flow according to a predetermined regime. Intermittent flow may comprise a flow occurring in a consecutive plurality of similar time periods separated by similar intervals. The extent of each time period may be the same as, or different from each time interval. The plurality of time periods may comprise three and the plurality of time intervals may also comprise three.

Two embodiments of the invention will now be described by way of example with reference to the accompanying drawings, wherein:

FIGURE 1 is a diagrammatic illustration of a flow control means embodying the invention,

FIGURE 2 is a diagrammatic illustration of a flow sensing means, and

FIGURE 3 is a diagrammatic illustration of a second flow control means embodying the invention.

Referring to the drawings, a water supply pipe 10 is provided with a flow control means 11 embodying the invention at a position adjacent the entry 12 of the pipe 10 into a premises, for example, through a wall 13 thereof and upstream of distribution points 14. The flow control means comprises a solenoid operated valve 15 which can either permit or interrupt flow of water along the pipe 10. The valve 15 is moveable between its open and closed conditions by a solenoid 16 under the control of a control means 17.

The control means 17 receives a signal to indicate whether or not fluid is flowing in the pipe 10 from a flow sensing means 18. In the present example the flow sensing means 18 comprises a sensing element 20 which is moveable within a housing 21. Water from the pipe 10 enters the housing 21 through an

inlet port 22 and exits through an exit port 23. Flow of liquid through the exit port 22 urges the sensing element 20 towards a sensing position 24 whereat the position of the sensing element is detected by a proximity sensor which in the present example comprises a magnetic proximity sensor 25, the sensing element 20 comprising magnetic material. If desired, however, any other suitable flow sensing means may be provided such as a rotary impeller.

The valve 15 may be of any desired configuration and may, for example, be a gate valve, a butterfly valve, or a valve having a valve member moveable into and out of sealing engagement with a valve seat as a result of movement of the valve member in the direction of fluid flow.

In all cases the valve member of the valve 15 is moveable by a solenoid 16 which is energised by the control means 17.

The control means 17 is provided with a primary electric supply on a line 25 which in the present example is a 6 volt supply which is transformed by a transformer 26 from mains voltage supplied on line 27. A secondary supply 28 is also provided in the form of a battery so as to operate the flow control means in the event of electrical mains failure.

Manual override means are provided whereby the valve 15 can be manually moved between its open or its closed condition as desired.

In use, the control unit 17 is set so as to determine a predetermined time period. The time period is chosen so as to be longer than the normal period for which any water is drawn from the line 10 by the distribution means 14 but at the same time is not so long that unacceptable damage can occur in the event of a leak in pipe 10 downstream of the flow control means 11.

The control means 17 includes logic means to determine whether or not the flow sensing means 18 has detected uninterrupted liquid flow for the above mentioned predetermined time period. If such uninterrupted flow is determined to have occurred for the time period the control means 17 causes the solenoid 16 to be operated to move the valve 15 to its closed condition.

Alternatively, if the logic means determines that flow has been interrupted before the expiration of the time period, then the timer is reset and the valve 15 is maintained in its open condition.

The control means is arranged to cycle the valve 15 from its open condition to its closed condition and back to its open condition at a predetermined time interval independently of water flow so as to ensure that the valve 15 is maintained in a fully operable condition and, for example, to ensure that operation of the valve is not obstructed due to the presence of, for example, scale. If desired the valve 15 can be thus cycled according to other criteria such as on each or after a number of flow commencements.

When the control means operates the valve 15 to move it to the closed condition after determining that flow has continued uninterruptedly for the time period, the control means is arranged so that it cannot be activated until the control circuit has been manually reset.

The present invention therefore provides a convenient relatively simple flow control means to protect premises from water damage due to a leak occurring. Provision of the battery 28 ensures safe operation of the device even in the event of a power failure. The flow control means may be used to similarly control flow in any other application and of any other suitable liquid or gas.

A modification of the embodiment shown in Figures 1 and 2 is illustrated with further reference to Figure 3. In which the same reference numerals have been used to refer to corresponding parts as were used in Figures 1 and 2. Again, a water supply pipe 10 enters the premises and is provided with a valve 15 moveable between open and closed conditions by a solenoid 16 under the control of a control means 17 as described in more detail in connection with the first embodiment.

In this embodiment the control means 17 receives a signal from a first flow sensing means 18a which is or may be a relatively high flow rate sensor. In addition the control means 17 receives a signal from a second flow sensing means

18b which is a low flow sensor capable of sensing very low flow rates but which may not be capable of passing high flow rates.

Also included in the pipework 10 is a check valve 30 which is normally closed so as to prevent low flow rate passing through the first flow sensing means 18a. At higher flow rates the check valve 30 opens to allow water to pass through the item 30 at up to the maximum flow rate of the pipework. In addition first flow sensing means 18a, whilst adapted to provide an electrical signal indicating flow at low to medium flow rates, is of a suitable size to pass the maximum flow rate of the pipework. The first and second flow sensing means 18a,18b may be a flow sensing means of any desired type including those described in connection with the first embodiment. The valve 15 may be as described in connection with the first embodiment and the valve member of the valve 15 may be moveable by a solenoid 16 which is energised by the control means 17. Of course if desired in either embodiment, the valve member may be disposed so that the valve member 15 may be in a position to permit flow either when the solenoid is energised or when the solenoid is de-energised, the control means being arranged according to the appropriate alternative.

Manual override means may be provided if desired and control means may be arranged to cycle the valve between open and closed conditions, for example, after predetermined time intervals, to ensure that the valve operation does not become obstructed, such as by the formation of scale or as in connection with the first embodiment.

In this embodiment, in use, the control unit 17 is set so as to determine a single predetermined time period. The time period is chosen so as to be longer than the normal period for which any water is drawn from the line 10 by the distribution means 14 but at the same time is not so long that unacceptable damage can occur in the event of a leakage in a pipe 10 downstream of the flow control means 11 is detected by either flow sensing means 18a, 18b. Ten minutes may be a typically selected time.

The control means 17 includes a logic means to determine whether or not either flow sensing means 18a, 18b has detected intermittent liquid flow. If such intermittent flow is determined, the control means 17 causes the solenoid 16 to be operated to move the valve 15 to its closed condition.

If the logic means determines that the flow has been interrupted permanently before the expiration of the time period, then the time is reset and the valve 15 is maintained in its open condition. Of course if the logic means does not determine that any flow has been detected, the valve means 15 remains open.

The control means 17 also includes a logic means to determine whether or not either flow sensing means has detected uninterrupted liquid flow for the above mentioned predetermine time period. If such an uninterrupted flow is determined to have occurred for the time period the control means 17 causes the solenoid 16 to be operated to move the valve 15 to its closed condition.

Alternatively, if the logic means determines that flow has been interrupted before the expiration of the time period, then the time is reset and the valve 15 is retained in its open condition.

If desired, the logic means may comprise a microprocessor programmed with an algorithm. The logic means may determine that the flow has occurred in a consecutive plurality of similar time periods separated by similar time intervals. The logic means may determine that flow has occurred for a time extent which falls within one or more successive time blocks so that the total of the successive time blocks within which flow has occurred comprises a first time period. For example, if each time block comprises 15 seconds and flow has occurred for any time lying in the range 46-60 seconds, the logic means will determine that flow has occurred within four time blocks so that a first time period of 60 seconds will be determined. The logic means stores this first time period.

The logic means also determines that flow has not occurred for a time extent falling within one or more successive time blocks so that the total of the

successive time blocks in which the flow does not occur comprises a first time interval. For example, where each time block has an extent of 15 seconds, if a flow occurs for any time lying within the range 76-90 seconds the logic means will determine that six time blocks have elapsed without any flow and so the first time interval will be determined as being 90 seconds. The logic means stores this first time interval.

If a second fluid flow is within the same time period as the first time period followed by no flow for the same time interval as the first time interval and then a third fluid flow is also within the same time period as the first time period, followed by no flow, within same time interval as the first time interval intermittent flow is determined as having taken place by the logic means. If the above-mentioned criteria are not achieved in any way, the logic means does not determine that intermittent flow has occurred. The number of time blocks comprising the first time period and the first time interval may, of course, vary, the logic means storing each such resultant time period and time interval and determining a repeated pattern of similar time periods and intervals for determination of intermittent flow.

If desired, the number of consecutive similar time periods and/or time intervals in said plurality may vary. In the example described above, a plurality of similar time periods and intervals comprises three of each and, if desired, they may each comprise a different number suitable for the circumstances involved. Furthermore, the length of each time block may vary from the 15 second length mentioned above by way of example.

A normal operating sequence will be the opening of a tap to start water flowing. This will give a signal from the second low flow rate sensing means 18b immediately followed by opening of the check valve 30 and a signal indicating flow from the first sensing means 18a.

A leak in the main high pressure cold water system may be detected by either flow sensing means 18a or 18b, depending upon the leakage rate, sensing flow for a longer time than is set on the control timer.

If the system includes a secondary circuit such as a hot water or central heating system which is fed from a separate storage tank provided with a contents sensitive inlet valve then the following circumstances may arise. In the event of a major failure in the secondary circuit, such as a split tank, then a high and constant flow of water would result which would be sensed by the first sensing means 18a as described herebefore.

However, if a relatively minor leak in such a circuit occurs this would result in partial opening of the inlet valve, for example a ball cock, to top-up the storage tank, but this would shut off within the above referred to predetermined time. By incorporating the second low, flow rate sensing means 18b and including logic so that if it is actuated on a repeated basis as a result of said interrupted flow such minor failure in the secondary circuit can be determined and the control logic arranged to close the valve 15.

If desired, although in this embodiment described with reference to Figure 3, a common valve 15 actuating means 16 and control means 17 together with a common predetermined time period has been described, if desired a separate valve 15 and/or actuating means 16 and/or control means 17 may be provided, associated with each flow sensing means 18a or 18b. A different time period may be set as the time period to be utilised. Different or additional regimes of use are possible. For example, a slow continuous flow rate may be determined due to a slow leak upstream of a storage tank being provided in the system, or due to no storage tank being provided in the system, or due to a storage tank inlet valve being partially open continuously to match or substantially match a leak flow downstream of the storage tank. Alternatively, a fast intermittent flow rate may be determined due to a large leak downstream of storage tank. The system described above, with a suitable logic means which may comprise a microcomputer of conventional type programmed with the desired control algorithm, can accommodate various regimes of use.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in

terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, or a class or group of substances or compositions, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A flow control means comprising a flow sensing means, a valve means, actuating means to move said valve means between an open and a closed condition, a control means to cause said actuating means to move said valve means between said open and closed conditions in accordance with a predetermined flow of said fluid, wherein the flow control means comprises means to move said valve means to said closed condition to interrupt flow of fluid therethrough upon intermittent flow of fluid past said sensing means.

2. A flow control means according to claim 1 wherein the flow control means comprises means to move said valve means to said closed condition to interrupt the flow of fluid therethrough after uninterrupted flow of fluid past said flow sensing means for a predetermined time period.

3. A flow control means according to claim 1 or claim 2 wherein the flow sensing means comprises at least one of:

a) a first flow sensing means adapted to sense a relatively high flow rate and wherein said control means causes said actuating means to move said valve means to said closed condition to interrupt said flow of fluid therethrough after said uninterrupted flow of fluid past said first flow sensing means for said predetermined time period, and/or upon said intermittent flow of fluid past said first flow sensing means,

b) a second flow sensing means adapted to sense a relatively low flow rate and wherein said control means is adapted to cause said actuating means to move said valve means to said closed condition to interrupt flow of fluid therethrough upon said intermittent flow of fluid past said

second flow sensing means and/or after uninterrupted flow of fluid past said second flow sensing means for a predetermined time period.

4. A flow control means according to claim 3 wherein both a first flow sensing means and a second flow sensing means is provided and the valve means, actuating means, and control means each comprise a common component associated with the two flow sensing means.

5. A flow control means according to claim 1 wherein both a first flow sensing means and a second flow sensing means is provided, the first flow sensing means is associated with a first valve means and/or a first actuating means and/or a first control means whilst the second flow sensing means is associated with a second valve means and/or a second actuating means and/or a second control means.

6. A flow control means according to any one of the preceding claims wherein the valve means is provided in a water supply to a domestic, commercial or industrial, or other premises.

7. A flow control means according to any one of the preceding claims wherein the same device is utilised to provide said first and/or said second flow sensing means.

8. A flow control means according to any one of the preceding claims wherein the or each flow sensing means comprises one of a rotary impeller caused to rotate by flow of said fluid or a sensing element moved by flow of said element towards a sensing position whereat presence of the sensing element is determined by a proximity sensor.

9. A flow control means according to any one of the preceding claims wherein the or each actuating means comprises a solenoid.

10. A flow control means according to any one of the preceding claims wherein the or each valve means comprises a gate valve, the gate being moveable between said open and closed positions by said solenoid.

11. A flow control means according to any one of claims 1 to 9 wherein the or each valve means comprises a butterfly type valve, the butterfly being rotated by said solenoid between said open and closed positions.

12. A flow control means according to any one of claims 10 to 12 wherein the or each valve means comprises a valve member moveable into and out of sealing engagement with a valve seat in the direction of flow of fluid past the seat by said solenoid.

13. A flow control means according to any one of claims 10 to 12 wherein the solenoid moves the valve means between both conditions in either direction or moves the valve means in one direction and resilient biasing means being provided for return movement.

14. A flow control means according to any one of the preceding claims wherein the, or one of the, control means comprises a timing device and logic means to determine whether or not flow has stopped before the timing device has measured said predetermined time period.

15. A flow control means according to any one of the preceding claims wherein if flow has stopped before the first predetermined time period has elapsed, the control means is reset to restart measuring the first time period.

16. A flow control means according to claim 14 wherein if the flow continues after the predetermined time period has elapsed the actuating means is caused to move the valve means to the closed condition.

17. A flow control means according to any one of the preceding claims wherein the, or one of the, control means comprises a timing device and logic means to determine whether or not flow is intermittent.

18. A flow control means according to claim 17 wherein if intermittent flow occurs, the control means is operative to close the valve means.

19. A flow control means according to any one of the preceding claims wherein means are provided to prevent the valve means being opened until the control means has been manually reset after movement of the valve means to the closed condition.

20. A flow control mans according to any one of the preceding claims wherein the predetermined time period is adjustable.

21. A flow control means according to any one of the preceding claims wherein the flow control means is provided with a primary power supply.

22. A flow control means according to claim 21 wherein the primary power supply comprises a low voltage supply transformed from a mains supply.

23. A flow control means according to claim 21 or claim 22 wherein the flow control means is provided with a secondary power supply.

24. A flow control means according to claim 23 wherein the secondary power supply is a battery.

25. A flow control means according to any one of the preceding claims wherein a manual override is provided to enable the or each valve to be manually moved to its open or its closed condition.

26. A flow control means according to any one of the preceding claims wherein the control means is arranged to cycle the or each valve between said open and closed conditions to ensure that the valve operation does not become obstructed.

27. A flow control means substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

28. A method of flow control comprising means to interrupt said flow in accordance with a predetermined flow of said fluid, comprising the step of interrupting flow of fluid upon intermittent flow of fluid.

29. A method according to claim 28 comprising the step of interrupting flow of fluid after uninterrupted flow of fluid for a predetermined time period.

30. A method according to claim 28 or claim 29 comprising at least one of the following steps:

a) sensing a first relatively high flow rate and interrupting flow of fluid after said uninterrupted fluid for a first predetermined time period and/or upon said intermittent flow of fluid,

b) sensing a second relatively low flow rate and interrupting flow of fluid upon said intermittent flow of fluid and/or after said uninterrupted flow of fluid for said predetermined time period.

31. A method of flow control substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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